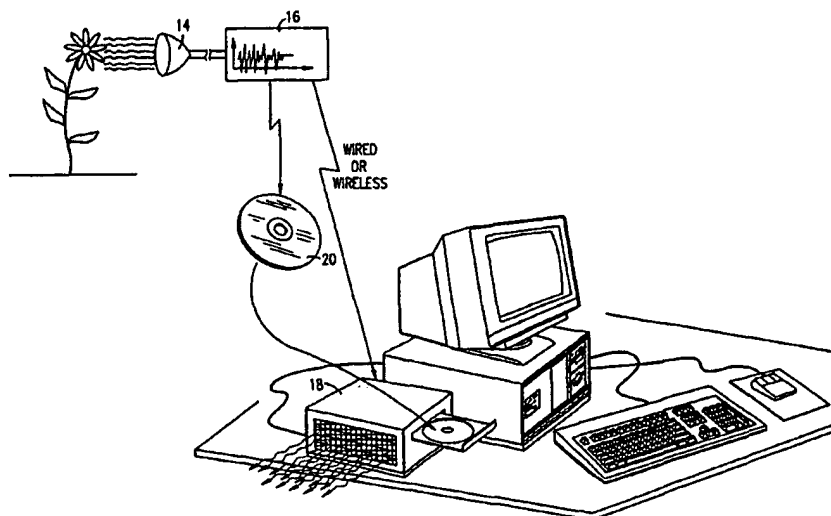




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<p>(21) International Application Number: PCT/IL99/00494</p> <p>(22) International Filing Date: 9 September 1999 (09.09.99)</p> <p>(30) Priority Data: 126167 10 September 1998 (10.09.98) IL</p> <p>(71) Applicant (for all designated States except US): AROMIX TECHNOLOGIES LTD. [IL/IL]; Galgalei HaPlada Street 6, 46722 Herzliya (IL).</p> <p>(72) Inventor; and</p> <p>(75) Inventor/Applicant (for US only): FISCH, Eliezer [IL/IL]; Moshe Sne Street 15, 43728 Raanana (IL).</p> <p>(74) Agents: SANFORD, T., Colb et al.; Sanford T. Colb &amp; Co., P.O. Box 2273, 76122 Rehovot (IL).</p>	<p>(81) Designated States: AE, AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), DM, EE, EE (Utility model), ES, FI, FI (Utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).</p> <p><b>Published</b> With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</p>	

(54) Title: METHODS AND APPARATUS FOR ODOR TRANSMISSION



## (57) Abstract

This invention discloses a system for reproducing arbitrary odors which need not be predetermined or previously known, the system includes a set of predetermined odorants, an odor sensor which produces information representing an arbitrary input odor which need not be predetermined or previously known, and an odor output device which receives the information representing an arbitrary input odor which need not be predetermined or previously known, and utilizes the set of predetermined odorants to reproduce an approximation of the arbitrary input odor based on the information, and wherein the odor sensor and the odor output device are linked by an information transmission link. A method for reproducing an odor is also disclosed.

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## METHODS AND APPARATUS FOR ODOR TRANSMISSION

### FIELD OF THE INVENTION

5           The present invention relates generally to apparatus and methods for generation, emission, transmission, reproduction and memory storage of fragrances, scents, odors and smells.

### BACKGROUND OF THE INVENTION

10           Apparatus and methods for sensing odors are well known in the art. For example, sensing, identifying or categorizing a particular odor may be accomplished by means of gas chromatography devices and mass spectrometers which chemically analyze an odor, and electronic or artificial "noses" which provide a characterizing signature of the odor.

15           Odor output devices for delivery of fragrances to a user's nose are also well known. For example, a fragrance output device used in conjunction with virtual reality systems is described in US Patent 5,591,409 to Watkins. US Patent 5,724,256 to Lee et al. describes a fragrance emission device which can be used in multimedia systems.

20           Systems which attempt to link odor sensing devices with odor delivery devices are known in the prior art. For example, "Transmission of Olfactory Information for Telemedicine", Keller *et al.*, Interactive Technology and the New Paradigm for Healthcare, K. Morgan *et al.*, eds., IOS Press and Ohmsha, Amsterdam, 1995, chapter 27, pp. 168-172, contemplates sensing known, predetermined odors with sensing  
25           devices, transmitting odor information related to the known odors to an odor output device, and using the output device to emit the known input odor. It is important to note that this reference and the above cited fragrance output devices of the art strive to attain an *emission* of a *predetermined* odor.

30           Over the years there have been many attempts to find explanations for odor sensation. Most of the theories used an analogy to color vision and assumed there are primary odors in smell just as there are primary colors (Red/Green/Blue or RGB) in

are primary odors in smell just as there are primary colors (Red/Green/Blue or RGB) in vision. Beginning with the pioneering work of John Amoore in the 60's, researchers have investigated the physical and chemical attributes of odorant molecules to try to find a correlation between such attributes and odorant quality perception. In an attempt to find a systematic way to classify odors and to define an odor code (Amoore JE, Specific anosmia: a clue to the olfactory code, Nature. 1967, 214(93):1095-8).

However, more than 30 years later, there is still no accepted way to define primary odors and to utilize a code to mix odorants at will, so as to recreate an arbitrary odor sensation. There have been whimsical and April-Fools-Day essays about an odor-version of RGB. For example, in May 1998 there appeared on the Internet a website with the domain name [www.vol.it/sbdi/44/sbdi44it.htm](http://www.vol.it/sbdi/44/sbdi44it.htm), which described an odor system having 7 basic "RGB" odors - camphor, moss, flowers, mint, ether, putrid odor, and pungent odor. It is noted that this allegation is a pale imitation of the original Amoore proposed scheme of seven primary odors, which has been long since recognized in the art to be simplistic, and even erroneous. Another joke of note in the Internet is the website of RealAroma at that describes a machine with 3 basic "RGB" odors.. However, not withstanding such published farces, the prior art does not currently know of any primary odors which are analogous to primary colors.

In summary, it is clear that the prior art does not seriously address a fundamental problem of odor transmission: how to communicate and reproduce an arbitrary odor which is not predetermined or previously known.

## SUMMARY OF THE INVENTION

The present invention seeks to provide apparatus and methods for communicating and reproducing arbitrary odors which need not be predetermined or previously known.

It is noted that throughout the specification and claims the terms fragrances, aromas, flavors, scents, odors and smells, and any derivatives thereof, are used interchangeably. The term "odorant" denotes a substance which contributes to an emission of an odor by an odor output device. The odorant does not necessarily give off

an odor, but may catalyze emission of an odor. The odorant may be a pure substance or a mixture of substances.

In accordance with a preferred embodiment of the present invention, an odor sensor senses an arbitrary input odor, which need not be predetermined or previously known, and provides odor information representing the input odor. For example, the odor sensor may employ gas chromatography to analyze the arbitrary odor and represent it as a series of chemical constituents. The odor information may comprise principal peaks of such chemical constituents. The odor information is next transmitted to an odor output device. The odor output device preferably contains an odorant palette which includes a plurality of odorants which are known to give rise to many natural or artificial odors. The number of odorants used is arbitrary and can be great or small depending on the particular application.

The odor information is used by the odor output device to choose and combine odorants in the proper proportions and concentrations to approximate the particular input odor. For example, the odor output device may choose odorants corresponding to the principal peaks contained in the odor information and mix them in accordance with the odor information to arrive at a composite output odor which approximates the arbitrary input odor. It is a particular feature of the present invention to use the odor information containing the principal peaks to instruct the odorant palette to *approximate arbitrary odors which need not be predetermined or previously known.*

The present invention also provides a method for constructing an odorant palette. For example, gas chromatography may be used to provide odor information regarding a *plurality* of input odors. The odor information contains certain primary peaks corresponding to primary odor components which characterize the odor. From the set of odor information of all of the input odors, a subset of the *n* most primary odor components is obtained. The odorant palette is then constructed by selecting odorants which produce the *n* most primary odor components. These odorants can then be mixed in proportions and concentrations to approximate arbitrary odors which need not be predetermined or previously known. These odorants thus behave as an approximation to the illusory "RGB" odorants, unsuccessfully sought by the prior art.

The following is an illustrative example of the type of odor transmission possible with the present invention and not possible with the prior art: An aroma technician on a movie set may add fragrances to scenes in a plurality of movies. In the prior art, such a technician would have had to decide precisely which odors would be transmitted and would have had to provide in every theater showing the movie all the odorants needed to reproduce all of the predetermined odors. In contrast, the technician can use the methods and teachings of the present invention to employ a standard set of odorants found in each suitably equipped theater to provide an approximation of the desired odors without having to provide a special set of odorants for each movie.

In conjunction with the abovementioned methods of the present invention, there is also provided an improved fragrance dispenser which can be used to generate odors by combining various concentrations of basic odorants. The fragrance dispenser comprises a plurality of odorant sites, each of which is a reservoir of one of these primary odors. In accordance with the teachings of the present invention, the fragrance dispenser is instructed to mix the correct proportions of odorants to approximate any odor. Output odors are generated selectively into the ambient air as a combination of odors released from the odorant sites.

The odorant sites may be manufactured, for example, by encapsulating a liquid or solid active ingredient within a selectively-permeable enclosure. The enclosure normally shields the odor from diffusing into the surrounding environment. The enclosure permits passage of the odor into the ambient air upon application of predetermined level of energy, for example thermal energy, to the enclosure

There is thus provided in accordance with a preferred embodiment of the present invention a system for reproducing arbitrary odors which need not be predetermined or previously known, the system including a set of predetermined odorants, an odor sensor which produces information representing an arbitrary input odor which need not be predetermined or previously known, and an odor output device which receives the information representing an arbitrary input odor which need not be predetermined or previously known, and utilizes the set of predetermined odorants to reproduce an approximation of the arbitrary input odor based on the information, and

wherein the odor sensor and the odor output device are linked by an information transmission link.

In accordance with a preferred embodiment of the present invention the odor output device includes an array of odorant sites, each the odorant sites including an  
5 odorant in an enclosure, the enclosure allowing passage of the odor therethrough upon application of predetermined level of energy to the enclosure, and a plurality of electrical wires embedded in the enclosure, wherein an electrical current flowing in each the wire heats the enclosure to a temperature which causes release of odor from the enclosure.

Further in accordance with a preferred embodiment of the present  
10 invention a fan is provided which creates a flow of air over the odorant sites.

Still further in accordance with a preferred embodiment of the present invention the transmission link includes an encrypted transmission link.

There is also provided in accordance with a preferred embodiment of the present invention a system for reproducing arbitrary odors which need not be  
15 predetermined or previously known, the system including a set of predetermined odorants, and an odor output device which receives information representing an arbitrary input odor which need not be predetermined or previously known, and utilizes the set of predetermined odorants to reproduce an approximation of the arbitrary input odor based on the information.

20 In accordance with a preferred embodiment of the present invention an odor sensor is provided which produces the information representing an arbitrary input odor which need not be predetermined or previously known.

Further in accordance with a preferred embodiment of the present invention an odor recording medium is provided which is in communication with the  
25 odor sensor for recording the information, and the odor output device reproduces odors recorded on the odor recording medium.

There is also provided in accordance with a preferred embodiment of the present invention an odor output device including an array of odor sites, each the odor site including an odorant in an enclosure, the enclosure allowing passage of the odor  
30 therethrough upon thermally induced change of the enclosure, and a plurality of electrical

wires embedded in the enclosure, wherein an electrical current flowing in each the wire heats the enclosure to a temperature which causes the change of the enclosure.

There is also provided in accordance with a preferred embodiment of the present invention a method for reproducing an odor, including providing a set of predetermined odorants in an odor output device, providing odor information  
5 corresponding to an arbitrary input odor which need not be predetermined or previously known into the odor output device, and using the arbitrary odor information to combine the odorants in such proportions and concentrations so as to approximate the arbitrary input odor.

10 In accordance with a preferred embodiment of the present invention said providing odor information includes using gas chromatography to represent each the odor as a series of chemical constituents.

Further in accordance with a preferred embodiment of the present invention the arbitrary odor information is wirelessly transmitted to the odorant palette in  
15 real time.

Still further in accordance with a preferred embodiment of the present invention the arbitrary odor information is recorded for later transmission and reproduction.

There is also provided in accordance with a preferred embodiment of the present invention a method for constructing an odorant palette including providing odor  
20 information of a set of input odors, wherein the odor information contains principal peaks corresponding to principal odor components, selecting from the set of odor information of all of the input odors, a subset of  $n$  most principal odor components, and constructing an odorant palette by selecting odorants which produce the  $n$  most principal  
25 odor components.

### BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be understood and appreciated more fully from the following detailed description, taken in conjunction with the drawings in which:

30 Fig. 1 is a simplified flow chart of a method for odor transmission and reproduction in accordance with a preferred embodiment of the present invention;



Fig. 2 is a simplified flow chart of a method for constructing an odorant palette in accordance with a preferred embodiment of the present invention;

Fig. 3 is a simplified pictorial block diagram of an odor transmission system, constructed and operative in accordance with a preferred embodiment of the present invention; and

Fig. 4 is a simplified pictorial illustration of an odor output device constructed and operative in accordance with a preferred embodiment of the present invention.

#### DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Reference is now made to Fig. 1 which is a simplified flow chart of a method for odor transmission and reproduction in accordance with a preferred embodiment of the present invention. An odor sensor senses an arbitrary input odor, which need not be predetermined or previously known, and provides odor information representing the input odor. For example, the odor sensor may employ gas chromatography to analyze the arbitrary odor and represent it as a series of chemical constituents. The odor information may comprise principal peaks of such chemical constituents. The odor information is next transmitted to an odor output device. The information transmission may be accomplished by any convenient means, wired or wireless.

The odor output device may be any suitable kind of odor emission device of the art, such as those described in US Patents 5,591,409 to Watkins, or 5,724,256 to Lee et al., the disclosures of which are incorporated herein by reference. Alternatively, the odor output device may be constructed as shown and described hereinbelow with reference to Fig. 4. The odor output device preferably contains an odorant palette which includes a plurality of odorants which are known to give rise to many natural or artificial odors. The number of odorants used is arbitrary and can be great or small depending on the particular application.

The odor information is used by the odor output device to choose and combine odorants in the proper proportions and concentrations to approximate the particular input odor. For example, the odor output device may choose odorants

corresponding to the principal peaks contained in the odor information and mix them in accordance with the odor information to arrive at a composite output odor which approximates the arbitrary input odor. Of course, if the odor palette happens to contain exactly all of the odorants needed to reproduce these peaks, the output odor will likely  
5 be a very good replica of the input odor. It is clear that the accuracy of odor replication depends, *inter alia*, on how many odorants of which kind are used in the odorant palette. It is a particular feature of the present invention to use the odor information containing the principal peaks to instruct the odorant palette to approximate arbitrary odors which need not be predetermined or previously known.

10 The odorant palette may be constructed, for example, by utilizing existing odorants from such sources as perfume companies. Alternatively, the present invention provides a method for constructing an odorant palette as is now described.

Reference is now made to Fig. 2 which is a simplified flow chart of a method for constructing an odorant palette in accordance with a preferred embodiment  
15 of the present invention. An odor sensor senses a set of arbitrary input odors, and provides odor information representing the input odors, as described above with reference to Fig. 1. As mentioned before, the odor information contains certain primary peaks corresponding to primary odor components which characterize the odors. From the set of odor information of all of the input odors, a subset of the  $n$  most primary odor  
20 components is selected. An odorant palette is then constructed by selecting odorants which produce the  $n$  most primary odor components. The odorant palette is now ready for use as described in Fig. 1.

Reference is now made to Fig. 3 which is a block diagram of an odor transmission system constructed and operative in accordance with a preferred  
25 embodiment of the present invention.

An object such as a flower 12, whose odor is not necessarily previously known, is smelled by an odor sensor 14 which provides a smell signature 16 of the odor sensed. The smell signature 16 is transmitted, by wired or wireless transmission link, to an odor emitting device 18, the construction of which may be in accordance with known  
30 odor output devices of the art, or alternatively, as is described hereinbelow with reference to Fig. 4. The odor transmission may be in real time, or alternatively, sensed

odor information may be recorded, such as on an odor recording medium 20, e.g., the odorant sites and substrate described hereinbelow with reference to Fig. 4, for later transmission and reproduction. In addition, the transmission link may be encrypted for security purposes if desired. For example, known encryption algorithms, such as DES or  
5 RC-5, may be used to encrypt the transmission.

Reference is now made to Fig. 4 which illustrates an odor output device 150 constructed and operative in accordance with a preferred embodiment of the present invention. Odor output device 150 preferably includes an array of odor sites 152 mounted on a (preferably solid) substrate 154. Each odor site 152 includes a primary  
10 odor 156 in an enclosure 158. Enclosure 158 is preferably a heat-sensitive polymer, as described above for enclosure 18. A trigger 160 is provided which creates an opening in enclosure 158 by means of thermal energy sufficient for passage therethrough of odor 156.

Trigger 160 preferably includes a plurality of electrical wires 162  
15 embedded in enclosure 158. A power source 164, such as a battery, is connected to wires 162. Power source 164 supplies an electrical current to wires 162, thereby heating enclosure 158 to a temperature which causes thermally induced change in enclosure 158. A fan 166, such as a tube axial fan, draws fresh, ambient air in through inlet apertures 168, formed in a housing 170, over substrate 154 and odor sites 152. This air flow mixes  
20 the odors released from odorant sites 152 and then exits through an exit aperture 172 to a user (not shown). Odor output device 150 may also include a controller 174 connected to trigger 160 which controls which odorant sites 152 are triggered by trigger 160 to release odors 156, as described hereinabove.

It will be appreciated by persons skilled in the art that the present  
25 invention is not limited by what has been particularly shown and described hereinabove. Rather the scope of the present invention includes both combinations and subcombinations of the features described hereinabove as well as modifications and variations thereof which would occur to a person of skill in the art upon reading the foregoing description and which are not in the prior art.

## CLAIMS

What is claimed is:

1. A system for reproducing arbitrary odors which need not be  
5 predetermined or previously known, the system comprising:  
a set of predetermined odorants;  
an odor sensor which produces information representing an arbitrary  
input odor which need not be predetermined or previously known; and  
an odor output device which receives said information representing an  
10 arbitrary input odor which need not be predetermined or previously known, and utilizes  
said set of predetermined odorants to reproduce an approximation of said arbitrary input  
odor based on said information, and wherein said odor sensor and said odor output  
device are linked by an information transmission link.
- 15 2. The system according to claim 1 and wherein said odor output device  
comprises:  
an array of odor sites, each said odor site comprising an odorant in an  
enclosure, said enclosure allowing passage of the odor therethrough upon thermally  
induced change of said enclosure; and  
20 a plurality of electrical wires embedded in the enclosure, wherein an  
electrical current flowing in each said wire heats said enclosure to a temperature which  
causes thermally induced change of the enclosure.
3. The system according to claim 2 and comprising a fan which creates a  
25 flow of air over said odor sites.
4. The system according to claim 1 and wherein said transmission link  
comprises an encrypted transmission link.
- 30 5. A system for reproducing arbitrary odors which need not be  
predetermined or previously known, the system comprising:

a set of predetermined odorants; and  
an odor output device which receives information representing an arbitrary input odor which need not be predetermined or previously known, and utilizes said set of predetermined odorants to reproduce an approximation of said arbitrary input odor based on said information.

5 6. The system according to claim 5 and comprising:  
an odor sensor which produces said information representing an arbitrary input odor which need not be predetermined or previously known.

10 7. The system according to claim 1 or claim 5 and comprising:  
an odor recording medium in communication with said odor sensor for recording said information; and  
wherein said odor output device reproduces odors recorded on said odor  
15 recording medium.

8. An odor output device comprising:  
an array of odor sites, each said odor sites comprising an odorant in an enclosure, said enclosure allowing passage of the odor therethrough upon thermally induced change of  
20 said enclosure; and  
a plurality of electrical wires embedded in the enclosure, wherein an electrical current flowing in each said wire heats said enclosure to a temperature which causes thermally induced change of the enclosure.

25 9. The odor output device according to claim 8 and comprising a fan which creates a flow of air over said odorant sites.

10. A method for reproducing an odor, comprising:  
providing a set of predetermined odorants in an odor output device;  
30 providing odor information corresponding to an arbitrary input odor which need not be predetermined or previously known into said odor output device; and

using said arbitrary odor information to combine the odorants in such proportions and concentrations so as to approximate said arbitrary input odor.

11. The method according to claim 10 and wherein said providing odor  
5 information comprises using gas chromatography to represent each said odor as a series of chemical constituents.

12. The method according to claim 10 and comprising wirelessly transmitting  
said arbitrary odor information to said odorant palette in real time.

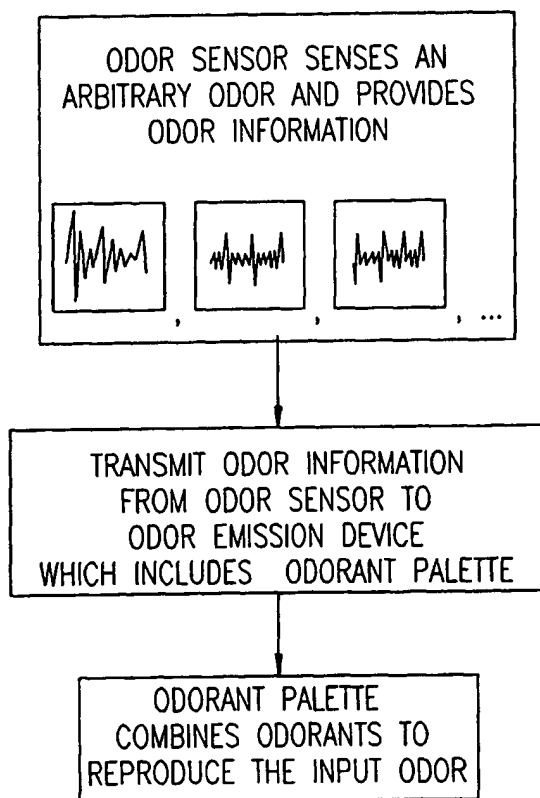
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13. The method according to claim 10 and further comprising recording said  
arbitrary odor information for later transmission and reproduction.

14. A method for constructing an odorant palette comprising:  
15 providing odor information of a set of input odors, wherein said odor  
information contains principal peaks corresponding to principal odor components;  
selecting from the set of odor information of all of the input odors, a  
subset of  $n$  most principal odor components; and  
constructing an odorant palette by selecting odorants which produce the  $n$   
20 most principal odor components.

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FIG. 1



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FIG. 2

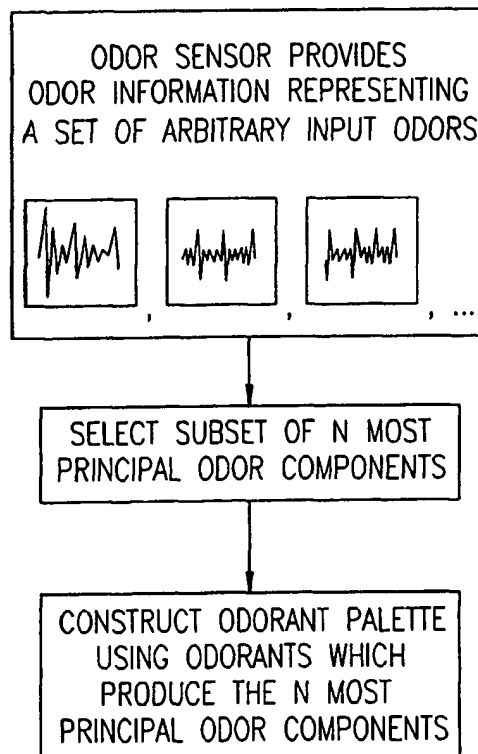




FIG. 3

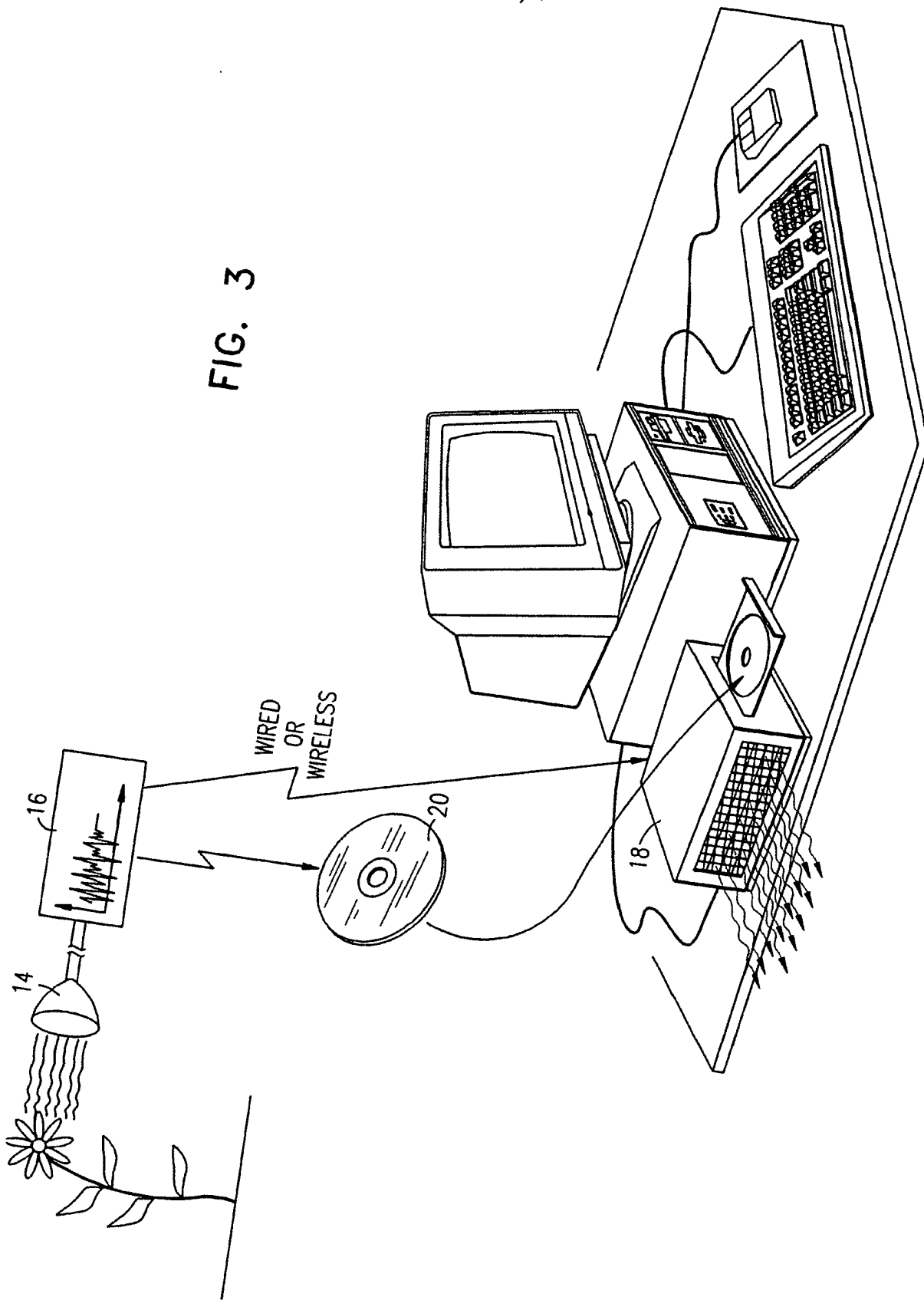
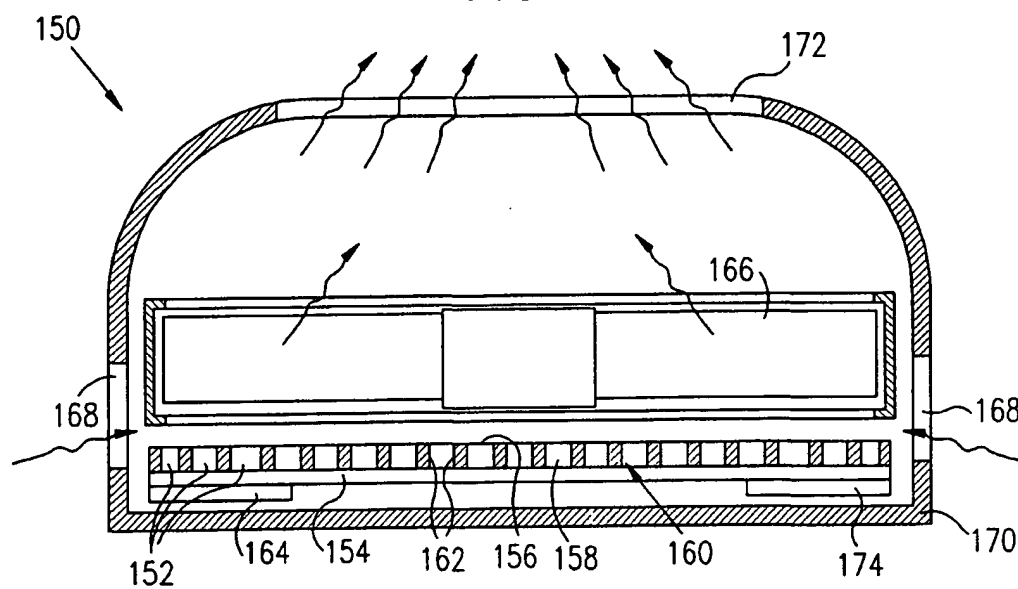


FIG. 4



# INTERNATIONAL SEARCH REPORT

International Application No

PCT/IL 99/00494

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 A61L9/03

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 A61L G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No
X	DATABASE WPI Section Ch, Week 199404 Derwent Publications Ltd., London, GB; Class D22, AN 1994-032884 XP002128260 & SU 1 785 699 A (POZDNYAKOV V N), 7 January 1993 (1993-01-07) abstract	1-10, 12-14
X	PATENT ABSTRACTS OF JAPAN vol. 1995, no. 06, 31 July 1995 (1995-07-31) & JP 07 055742 A (SHARP CORP), 3 March 1995 (1995-03-03) abstract	1,4-7, 10,12-14
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Further documents are listed in the continuation of box C



Patent family members are listed in annex

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Date of the actual completion of the international search

21 January 2000

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07/02/2000

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Authorized officer

Muñoz, M

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/IL 99/00494

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No
X	<p>DATABASE WPI  Section Ch, Week 199404  Derwent Publications Ltd., London, GB;  Class D22, AN 1994-032880  XP002128261  &amp; SU 1 785 695 A (POZDNYAKOV V N),  7 January 1993 (1993-01-07)  abstract</p> <p>---</p>	1,4-7, 10,12-14
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information on patent family members

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